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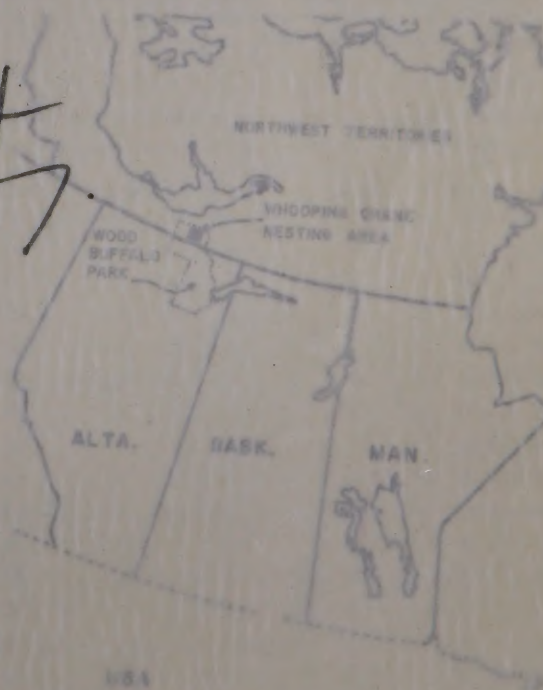
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Thank you for requesting a reprint of the above publication. Unfortunately, errors have crept into the paper during its longestation period at the printers. Several small errors in the text have been corrected. The major error is the inclusion of outdated Figures 2 and 3. Copies of the correct figures have been attached.

Yours truly,

E. Kuyt  
Wildlife Biologist  
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# POPULATION STATUS, NEST SITE FIDELITY, AND BREEDING HABITAT OF WHOOPING CRANES

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**Abstract:** Aerial surveys of the whooping crane (*Grus americana*) summer range 1966-1979 indicate a slow increase in the breeding population from about 10 pairs in 1968 to 19 pairs in 1979. Since 1975 the nonbreeding segment of the population has increased markedly, no doubt partly due to a succession of 3 years of excellent production of young and simultaneous below-average mortality of older birds. The proportion of known breeding birds in 1979 was 50% and recruitment from the large nonbreeding segment into the breeding population will probably occur in the next few years.

Breeding pairs' successive nest sites were close to each other and the mean size of composite nesting areas was 7.5 km<sup>2</sup>, although more than 70% of these areas were less than 5 km<sup>2</sup>. Whooping crane nests from adjoining pairs are usually more than 1 km apart. The most common nest material is roundstem bulrush (*Scirpus validus*); cattail (*Typha latifolia*) and sedge (*Carex* sp.) are less commonly used. There is no evidence that nests are reused. The breeding habitat is described; many other similar areas can be found in the vicinity of the breeding range but whooping cranes rarely occur there, presumably because there are not enough birds to occupy the vacant space.

The whooping crane is North America's most widely publicized bird. The species, listed as endangered, is making a slow comeback from a low of 15 wild birds in 1941 to the present 91 birds. The population migrates annually between the breeding range in Canada's Wood Buffalo National Park (WBNP) and the winter range in Aransas National Wildlife Refuge (ANWR) in Texas, USA. The Migratory Bird Treaty Act of 1916 requires Canada and the United States to protect whooping cranes and these obligations have resulted in a number of cooperative management programs.

Information on location, magnitude, and productivity of the breeding population is obtained from regular Canadian Wildlife Service (CWS) aerial surveys in WBNP (Fig. 1). Aerial census flights are carried out regularly by the staff of ANWR when the whooping cranes are wintering and the resulting population figures are accurate because all birds habitually winter on ANWR.

## POPULATION STATUS

Almost all of the range occupied in summer by breeding and nonbreeding whooping cranes lies in the Northwest Territories (NWT) portion of WBNP. Unlike the situation in ANWR, the total crane population is never accounted for in WBNP because manpower and funding restrictions prevent thorough searches for scattered nonbreeding birds in isolated areas uninhabited by man.

At the present time the NWT-Texas flock numbers 76, the highest on record. There also are 28 whooping cranes in captivity in the USA and 15 wild birds in the Rocky Mountain (foster-parent) population. All but a few of these 43 birds have been raised from WBNP eggs. Since 1967 when 9 nests were found, the breeding population has climbed to 19 pairs in 1979, an increase of less than 1 pair per year. The lowest point in the whooping crane population is generally accepted as having occurred in 1941 when only 15 wild birds were still believed to exist in the NWT-Texas flock. The only other wild population existing at the time, 6 sedentary birds in Louisiana, became extinct in 1949.

## Breeding Population

I believe that in 1966 and 1967 all breeding pairs may not have been located because of workers' unfamiliarity with the breeding area. However, recent small

increases appear to be due to new pairs becoming established in nesting areas hitherto uninhabited rather than to any undiscovered existing pairs. In 1970 a new nesting pair was located in the extreme northern portion of the breeding range where in 1977, 1978, and 1979 a second pair nested. A new pair first nested in the extreme southern part of the breeding range in 1977, returning there in 1978 and 1979. One or possibly 2 new pairs nested along the Kiewi River in 1979. At the same time we lost at least 1 nesting pair in the Sass area. There has therefore been a slight extension of the known breeding range and a small numerical increase in breeding pairs (Table 1).

In 1973, 1974, and 1975 the combined total of yearlings, subadults, and nonbreeding adults was less than



Fig. 1. Location of Wood Buffalo National Park and the whooping crane nesting area.



the corresponding years' known breeding population. This was the result, in part, of poor survival of young during spring and summer of 1973 and 1974. Since 1976, the situation has reversed, with the known nonbreeding population equal to (only in 1979) or less than the nonbreeding population (Table 2). The reversal is partly because of excellent survival of juveniles from 1975 to 1977. During years when surplus eggs were removed from the wild (for transfer to the U.S. Fish and Wildlife Service's Patuxent Wildlife Research Center, Maryland, USA, or to the foster-parent project at Grays Lake National Wildlife Refuge, Idaho; Table 3), survival of chicks from remaining eggs in WBNP was considerably higher than in years when eggs were not collected (Erickson 1976). With recruitment into the breeding population of birds previously in the nonbreeding segment the breeding population is expected to increase beyond the record of 19 pairs in 1979.

#### Nonbreeding Population

Age of wild whooping cranes at first breeding is not yet known but from observations of captive birds, and from limited observations of wild birds in the Rocky Mountain flock, this age is believed to be upwards of 3 years. In addition to breeding birds, the NWT-Texas flock probably contains sexually immature birds, adult cranes unable to find compatible mates, cranes having lost their mates, and senile birds. Under good field conditions, only the juvenile birds up to 1 year old can be distinguished from "adult" cranes by the presence of cinnamon-colored feathers of the juvenile plumage. None of the other nonbreeding white plumaged birds could be distinguished until 1978, the year after CWS began color-banding juvenile flightless whooping cranes (Kuyt 1978, 1979a). During aerial searches for nesting whooping cranes, I located banded nonbreeding birds in an area between 2 subsections of the breeding range (Kuyt 1979b). Fortunately, the area presently inhabited by nonbreeders is also well within the boundaries of WBNP.

Table 1. Location of whooping crane breeding pairs.

Year	Sass River	Klewi River	Nyarling River	Alberta	Total
1966	5	a	a	a	5
1967	6	3	a	a	9
1968	6	5	a	a	10
1969	5	7	a	a	12
1970	6	8	1	a	15
1971	7	5	1	a	13
1972	8	7	1	a	16
1973	7	6	1	a	14
1974	8	6	1	a	15
1975	8	7	1	a	16
1976	8	7	1	a	16
1977	8	6	2	1	17
1978	5	7	2	1	15
1979	7	9	2	1	19

<sup>a</sup>Not surveyed.

Color-banding has also revealed that there has been satisfactory survival of the 3 banded year classes. Among the 3 cohorts, 7 (1977), 5 (1978), and 6 (1979) are still alive (D. Blankinship, pers. comm.). One bird banded in 1979 failed to arrive at Aransas but a second, unbanded, juvenile survives.

#### NEST SITE FIDELITY

Before 1966, monitoring of the whooping crane population on summer range was restricted almost exclusively to aerial surveys over the Sass River area. Since 1966, aerial coverage of the Sass River area has been intensified and extended to the Klewi River drainage adjoining the Sass River. In 1970 a small portion of the marshes near the Nyarling River was surveyed for the first time along with areas between the Nyarling and Klewi Rivers. Small areas south of the Sass area came under survey in about 1974.

During early surveys it became obvious that whooping crane nest sites in successive years were close together. Whooping cranes are long-lived birds and, if homing instincts and nest site fidelity are as well established in whooping cranes as in other species, the nest of a particular pair of cranes should be close to its previous year's nest.

Since 1970-1971 all nest sites have been plotted on large-scale aerial photographs (2.5 cm = 300 m) and nests found earlier (originally plotted on older 1 inch = 1 mile air photos) transposed to the new air photos. I have plotted 192 whooping crane nests since 1966 and at no time have cranes used the same nest in consecutive years. New nests are built each year, usually close to the previous site and often on the same marsh.

After I had accumulated several years data, circles were drawn on the map encompassing clumped nest sites believed to be consecutive nests of particular pairs. In successive years a high proportion of nests have fallen within these circles (Figs. 2 and 3). A territory may best be defined as any defended area and the term implies hostility and site tenacity. Limited information provided by a ground crew filming whooping cranes in 1974 indicated frequent calling between members of 3 neighboring breeding pairs (R. Mackay, pers. comm.).

During aerial surveys I have noted that resident breeding birds attacked and chased off intruding single or paired whooping cranes. Territorial defense occurs, but because breeding whooping cranes need to establish dominance relations with only a few other whoopers, lightly populated breeding range and nesting areas of long-lived cranes are used for many years, extremely vigorous territorial encounters between neighboring breeding pairs are unlikely.

The circles on the maps encompassing clumped nests probably include territories used by a single pair in a succession of years and are referred to as composite nesting areas (CNA).

None of the breeding birds can be positively identified individually. I cannot, therefore, be certain that a breeding pair seen in a territory is the 1 observed there the year before, but some supportive evidence is available. For example I have been able to determine that 1 of the adults in CNA Sass-1 for several years had an apparent neck growth (photographed at close range by the National Film Board in 1974) and pairs using CNA Sass-3 and Klewi-7 have an apparent

Table 2. Composition NWT-Texas whooping crane population.

Year	Number of known breeding birds	Total population <sup>a</sup>	Juveniles <sup>a</sup>	Maximum no. of nonbreeders
1966	10	43	5	b
1967	18	48	9	b
1968	20	50	6	30
1969	24	56	8	32
1970	30	57	6	27
1971	26	59	5	33
1972	32	51	5	19
1973	28	48	1	20
1974	30	49	2	19
1975	32	57	8	25
1976	32	69	12	37
1977	34	70	10	36
1978	30	74	6	44
1979	38	76	6	38

<sup>a</sup>Data from Refuge Manager, Aransas National Wildlife Refuge, Texas.

<sup>b</sup>Date probably not complete.

Table 3. Disposition of whooping crane eggs collected 1967-1979.

Year	Estimated no. eggs produced	Eggs available	Eggs left	Eggs collected and disposition
1966	9-10	4-5	9-10	0
1967	17	6	11	6 Patuxent
1968	20	10	10	10 Patuxent
1969	22	10	12	10 Patuxent
1970	27-29	12-14	27-29	0
1971	24	11	13	11 Patuxent
1972	26-31	10	26-31	0
1973	26	12	26	0
1974	29	13	16	13 Patuxent
1975	31	14	15 <sup>a</sup>	14 Grays Lake
1976	32	16	16	15 <sup>b</sup> Grays Lake
1977	35	16	16 <sup>c</sup>	16 Grays Lake
1978	28	13	14 <sup>d</sup>	13 Grays Lake
1979	39	19	18 <sup>a</sup>	19 Grays Lake
Total	365-373		229-237	50 Patuxent 77 Grays Lake

<sup>a</sup>Both eggs in 1 nest were found destroyed at time of egg pickup.

<sup>b</sup>Sixteen eggs collected from nests (1 egg was addled) and only 15 eggs were shipped.

<sup>c</sup>Nest 15-77, containing 3 eggs, was found destroyed before egg pickup.

<sup>d</sup>Nest 15-78, with 1 egg, was abandoned before egg pickup.



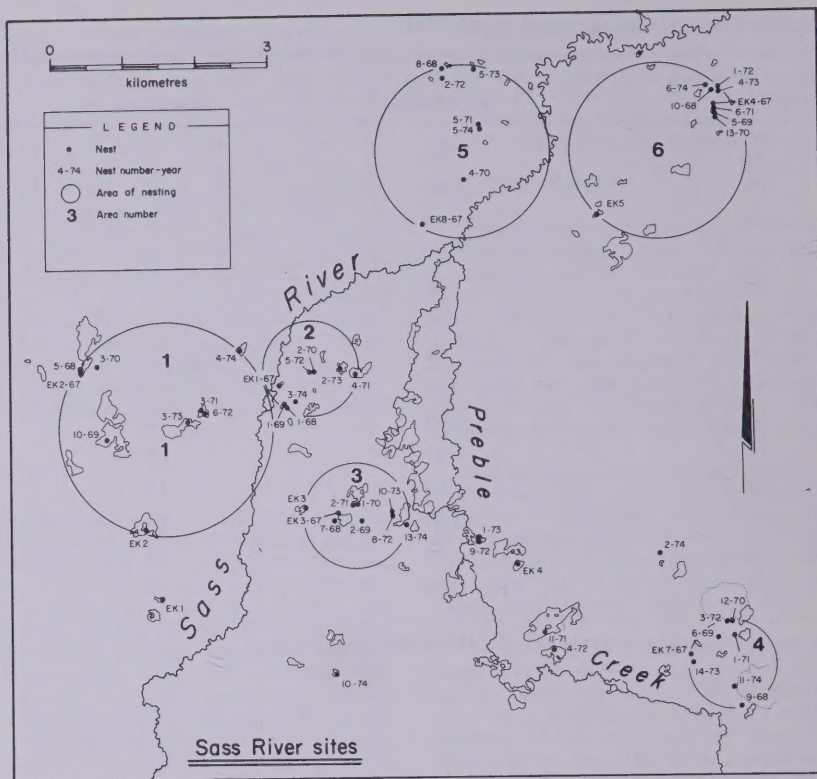


Fig. 2. Sass River whooping crane nesting areas, 1966-1979.

chronic inability to produce viable eggs. Thus, the composite nesting areas are of sufficient discreteness to give us confidence that each is used by the same pair in successive years.

Although whooping cranes are long-lived birds, eventually their reproductive life comes to an end and remaining partners may find a new mate. It is likely that the territorial bond is strong enough to cause the return of a former resident with its new mate to the old territory. Territories then may be reused many years and territories only become vacant if both adults disappear simultaneously.

After the eggs have hatched the chicks may use the nest for up to 3 days. Usually the family group moves gradually greater distances from the nest site using parts of its territory, not returning to the nest site but resting or brooding the chick when unfavorable weather or low temperatures are encountered. Movements of family groups are monitored at weekly intervals and locations plotted on air photos. I found that for most of the summer the family group remains within the circle indicating the composite nesting area and during that time the CNA may resemble the home range. Encroachment of 1 family on another's territory occurs rarely and then only when the resident family is on the opposite side of its territory.

Since 1977 we have color-banded juvenile whooping cranes on the breeding range. When the survivors of the banded cohorts become absorbed into the breeding population, and if bands remain visible, detailed information on nest site fidelity, pair bonding, and

many other aspects of whooping crane biology will become available.

#### DISTRIBUTION OF BREEDING PAIRS

Examination of the CNA's shows that not all areas are used uniformly as nesting sites. Some areas appear to be favored by the nesting pair and others are rarely used. In CNA Sass-1 the western portion of the area was used from 1967-1970. Many of the potential nesting ponds then became dry and since 1971 the central and northeastern portions of the CNA have been used, an area much smaller in size than the circled area.

CNA Sass-2 was not used by breeding cranes in 1978. The juvenile raised there in 1977 was color-banded that year and information from ANWR indicated that 1 of the adults accompanying the banded young died during the family's residence on the winter range. A single crane was seen in the CNA in 1978 and 1 year later a breeding pair was again in the territory.

CNA Sass-5 suffered from drought in late summer and, in 1977 and 1979, the family spent considerable time in the southern part of its territory near the more stable water conditions of the Sass River, and even touching CNA Sass-6, vacant since 1976. Sass-6 was used by a breeding pair each year from 1966-1976. In 1976 both eggs failed to hatch (they contained no identifiable embryo) and no pair has since returned.

The breeding pair in Sass-3 has a long history of unproductivity. Only a single egg was laid in several

years and eggs always failed to hatch due to unknown reasons. Both eggs laid in Sass-3 hatched in 1979 for the first time. Canadian chick 7-79 was killed by a wolf about 7 days before attainment of flight and Idaho chick 7-79 is still alive. Monitoring of the family in WBNP during the summer indicated that the family used the home range determined for the breeding pair usually nesting in CNA Sass-7. It is possible that with Sass-3 not being defended due perhaps to loss of the resident breeding pair, the pair from adjoining CNA Sass-7 was at liberty to nest in Sass-3.

In the Klewi River area, CNA Klewi-7 has a history somewhat similar to that of Sass-3. Nesting was first recorded in 1969 and has been irregular since then. One of the eggs produced in the area between 1969 and 1978 has hatched. In 1976 a nest was abandoned when the single egg disappeared shortly after having been laid. A second nest, apparently a reneesting, contained 2 eggs, neither of which hatched. In 1977 we

could not locate a nest in the area although a pair of cranes was observed a number of times. The following year an egg was laid in nest 3-78 on or about 4 May but the 2nd egg was not laid until about 8 May (eggs are usually laid a day apart). Neither of the 2 eggs hatched although a postmortem examination revealed embryo development and embryo death before hatching.

In 1979 a pair of whoopers nested 1.5 km southwest of the previous nest site and eggs were laid on about 9 and 12 May. The egg removed to Grays' Lake, Idaho, was destroyed there by a predator but the egg left in the nest in WBNP hatched. The chick, however, disappeared between 26 June and 3 July.

In CNA Klewi-6, three distinct marsh complexes were used. From 1967 to 1969 and in 1976 a large oval-shaped marsh surrounded by forest was used. The marsh had dried up by 1976 with the exception of a small portion in the west. From 1970 to 1972 and in 1978,

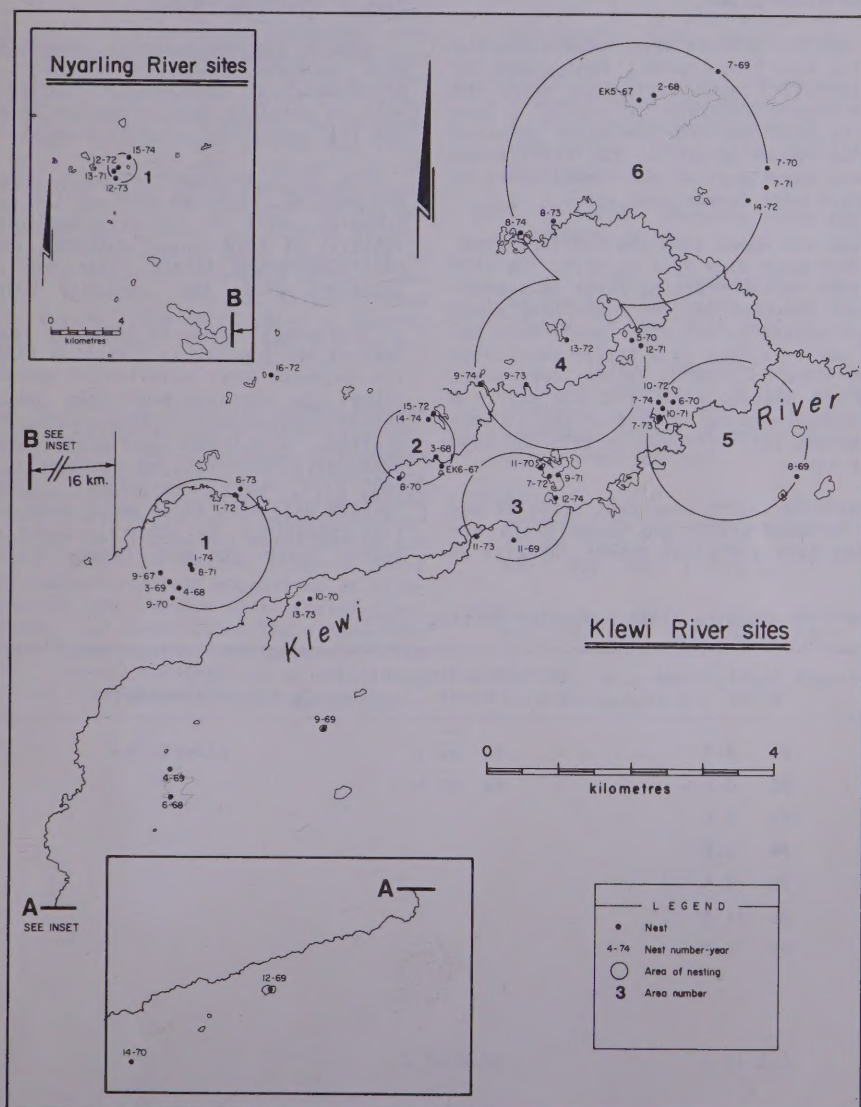


Fig. 3. Klewi and Nyarling Rivers whooping crane nesting areas, 1967-79.



nests were found in the northwest portion of another large marsh complex separated by coniferous forests from the other 2 marshes. Finally from 1973 to 1975, in 1977 and 1979, nest sites were found to the west, near the more stable water conditions of a branch of the Klewi River. Single feeding birds were frequently seen in 1 of 2 marsh complexes not used as nesting marshes in certain years and I think that these were mates of the incubating bird in the 3rd marsh.

Drought has also affected CNA Klewi-5. Since 1969 nests have not been found in the southeast portion and all nests since 1970 have been located near 1 of 2 branches of the Klewi River.

In CNA Klewi-4 there has been a westward shift in the nesting locations selected by the resident pair, perhaps in response to changes in pond water levels or to the encroaching trend of the resident pair in CNA Klewi-5. From 1974 to 1979 the pair in Klewi-4 used a small area near the widening of a creek flowing into the north branch of Klewi River.

In CNA Klewi-1 all but 4 nests were found along the eastern portion of a vast sedge marsh. Most often the cranes select a cattail (*Typha latifolia*) marsh and the nest consists almost entirely of cattail. From 1972 to 1973 and in 1978 and 1979 the birds selected nest sites near the north branch of the Klewi River but the family group spent most of the summer south of that branch and often near former nest sites.

Two nesting areas are known from the Nyarling area. Area 1 had a resident pair from 1971 to 1979. In 1976 the pair nested close to the Nyarling River on a shallow lake which has remained dry or almost dry since 1976. The pair had nested in all other years near the northeast side of the territory in a fairly small area estimated at about 8 km<sup>2</sup>. Area 2, in use only since 1977, is probably the nesting area of a new pair. A new pair was also found nesting in 1977 in the Alberta portion of WBNP and the pair returned in 1978 and 1979 to nest in a small area.

I have been unable to assign some nest sites to any particular CNA. In most situations these nests are scattered along the Sass and Klewi Rivers, usually at

considerable distances from existing CNA's. Klewi nests 17-79 and 19-79 are believed to be those of new or inexperienced pairs because the latter nest was located in an exposed area from which the egg was taken by a black bear (*Ursus americanus*) and a marked juvenile from the former nest wintered with its parents or a section of ANWR not previously used by whooping cranes (D. Blankinship, pers. comm.).

Nesting areas Klewi-1, Klewi-6, and Sass-4 are the most productive areas, 2 eggs being laid in each nest uninterruptedly from 1967 to 1979. Observations of banded birds on winter range in ANWR have shown that all 9 whoopers fledged from these 3 nests, during the last 3 years, are still alive (D. Blankinship, pers. comm.).

From 1966-1979, the nests closest together in any 1 year were 9-78 (CNA Klewi-4) and 13-78 (CNA Klewi-3), about 800 m apart.

#### SIZE OF BREEDING RANGES

Size of the CNA's varies considerably (Table 4). A more accurate evaluation of these areas, including measurement of breeding territories and home ranges, will be possible when juveniles marked in 1977, 1978, and 1979 enter the breeding population.

The CNA's presently contain large spaces not used for nesting, although most of the area is utilized by breeding pairs or family groups during their daily activity of feeding and resting. Only when juveniles have approached flight stage does the family group sometimes cross the arbitrary borders of the CNA.

Territorial behavior helps to ensure survival of part of the population (Erickson 1938). There is little evidence that territorial encounters of whooping cranes are anything more than frequent vocalizations between adjoining breeding pairs when incubation has started. Occasional challenging and pursuit of non-breeding interlopers, by a member of a resident breeding pair, may also occur. Frequent territorial fights near nest sites would draw attention of potential predators to the relatively conspicuous incubating crane and such fights would not be entirely

Table 4. Size (km<sup>2</sup>) of whooping crane composite nesting areas.

Sass River	Klewi River	Nyarling River	Alberta	All areas
#1 7.1	#1 3.3	#1 47.1	Alberta 0.4	
#2 1.9	#2 2.2	#2 22.4		
#3 1.7	#3 2.2			
#4 1.3	#4 4.8			
#5 4.4	#5 5.5			
#6 4.8	#6 11.2			
#7 1.9	#7 4.7			
#8 2.5				
Range				
1.3-7.1	2.2-11.2	22.4-47.1		0.4-47.1
Mean				
3.2	4.8	34.8	0.4	7.2



beneficial to the species. The present low density of nesting whooping cranes is probably responsible for the large breeding territories and extensive areas between adjoining territories where whoopers are rarely seen.

This arrangement undoubtedly is attractive to the long-lived whooping cranes which become closely attached to their breeding terrain and return year after year. Along with the relative quiet of the breeding territory, the cranes also find an adequate food supply and nest material. They become intimately acquainted with feeding areas and escape terrain (Tinbergen 1957). Fidelity to nest sites embodies all of these factors and is certain to enhance survival.

#### BREEDING HABITAT

The whooping crane breeding range as it is now known, and areas used by nonbreeders, lie near the northern edge of the Boreal Forest Region. Characteristic conifers found in the areas are white spruce (*Picea glauca*), black spruce (*P. mariana*), tamarack (*Larix laricina*), and jack pine (*Pinus banksiana*) with lesser amounts of deciduous broad-leaved species such as white birch (*Betula papyrifera*), quaking aspen (*Populus tremuloides*), and balsam poplar (*P. balsamifera*). Within the Boreal Forest Region the whooping crane's summer range is contained in the Hay River Forest Section (Rowe 1972) and lies just west of the limit of the Canadian Shield. Rocky escarpments scattered throughout the area are of Devonian age and are composed of limestone. As a result of glacial action, calcareous material constitutes a high proportion of the surface drift with resultant leaching of the lime-containing soils. Sinkholes are of fairly common occurrence in the region. The pH of water in nesting and feeding ponds was found to be from 7.6 to 8.3 (Novakowski 1966).

The areas used by whooping cranes in summer are the large marsh complexes adjoining the major watercourse, the Little Buffalo River and its small tributaries (Sass, Klewi, and Nyarling Rivers). In all instances the marshes are surrounded by elements of the boreal forest. Ponds, lakes, and bogs form a patchwork within the marsh complexes and individual water bodies are separated from each other by narrow ridges. These ridges consist of hummocky terrain supporting on higher ground a relatively open, mature white spruce-black spruce-lichen forest. On lower sites the ridges contain predominantly black spruce and tamarack. The understory of the forest consists of a relatively dense shrub layer of dwarf birch (*Betula glandulosa*),

willows (*Salix* sp.), sweet gale (*Myrica gale*), green alder (*Alnus crispa*), buffalo berry (*Shepherdia canadensis*), shrubby cinquefoil (*Potentilla fruticosa*), and several ericaceous shrubs, particularly Labrador tea (*Ledum groenlandicum*).

Ponds and lakes are shallow almost without exception. Crane nests are usually constructed in relatively shallow areas and mean water depth in 75 nesting ponds (measured 1 m from the nest edge, 1975-1979) was 25.4 cm. Dominant emergent vegetation in nesting ponds is bulrush (*Scirpus validus*), sedge (*Carex aquatilis*), and cattail. All three species are used as nest material by whooping cranes, bulrush most commonly and cattail rarely. Habitat, like that described, is common in northern WBNP and breeding habitat for whooping cranes does not appear to be a limiting factor.

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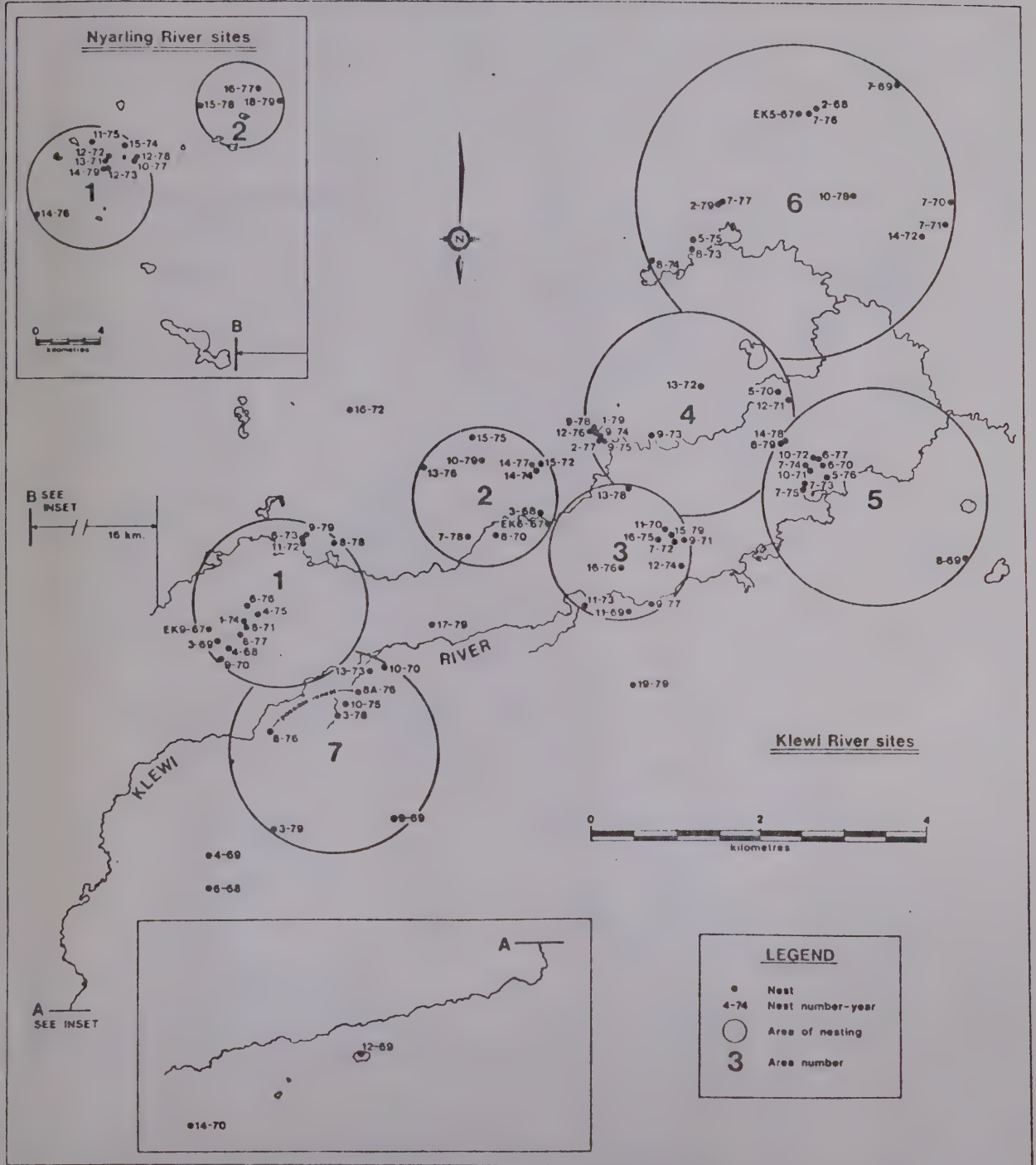


Figure 3. Klewi River and Nyarling River whooping crane nesting areas, 1967-1979.





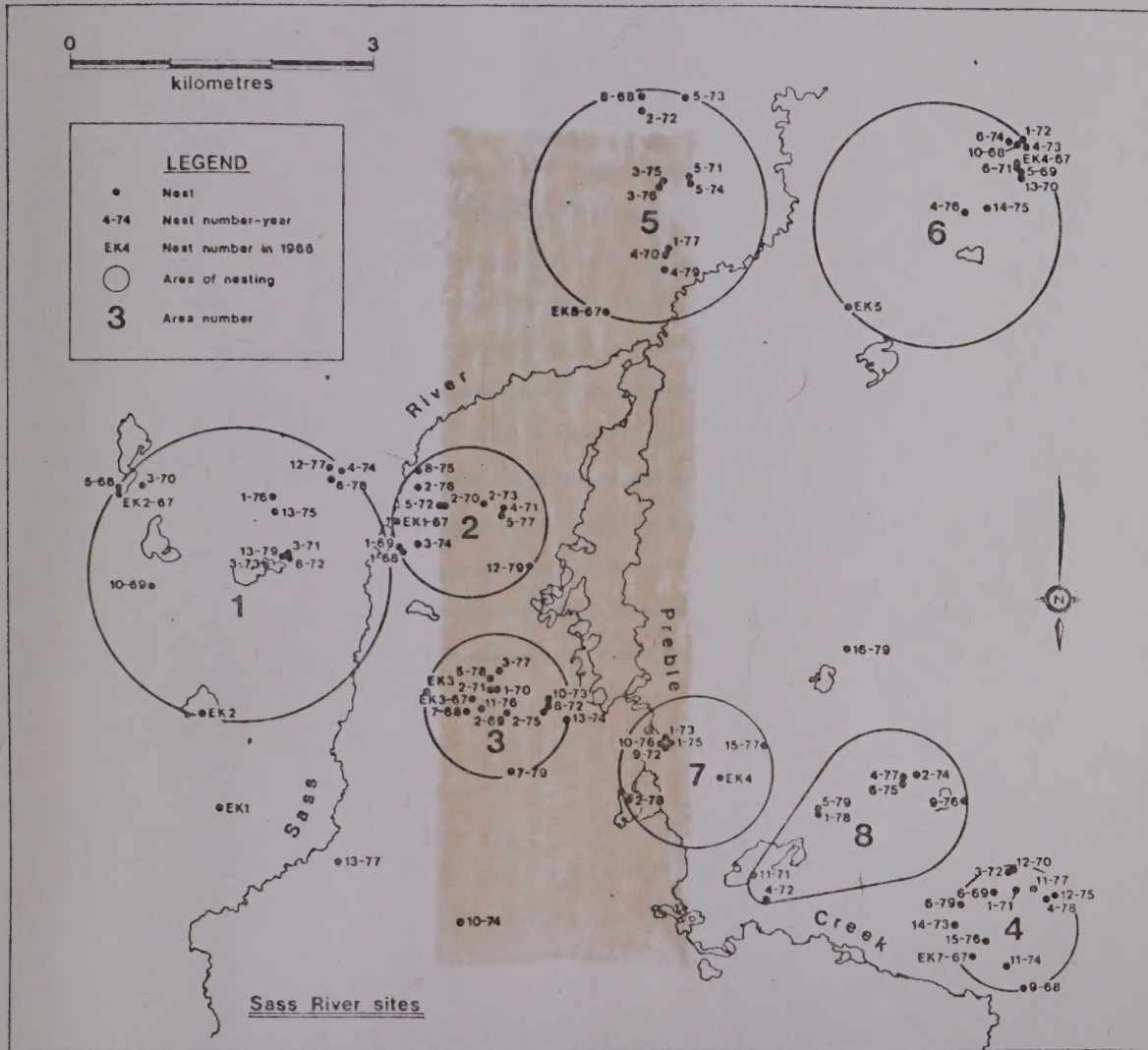


Figure 2. Sass River whooping crane nesting areas, 1966-1979.

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